February 14, 2017

BY ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: ***Use of Spectrum Bands Above 24 GHz for Mobile Radio Services, et. al.*, GN Docket No. 14-177, IB Docket No. 15-256, WT Docket No. 10-112, and IB Docket No. 97-95**

Dear Ms. Dortch:

In this proceeding, EchoStar Satellite Operating Corporation and Hughes Network Systems, LLC (collectively, "EchoStar") have submitted several analyses of and proposal for coexistence between the operations of Fixed-Satellite Service ("FSS") and Upper Microwave Flexible Use Service ("UMFUS") providers. With this letter, EchoStar supplements the record in two ways. First, in support of its Petition for Reconsideration, EchoStar presents an analysis of its earth stations already licensed to use the 27.5-28.35 GHz band ("28 GHz band") demonstrating that most of them would not have complied with the siting restrictions imposed in Section 25.136. Second, in support of its comments on the Further Notice of Proposed Rulemaking, EchoStar submits an alternative proposal for power flux-density ("PFD") limits for operations in the 37.5-40 GHz band ("39 GHz band") that are tailored to regional differences in atmospheric conditions across the United States, should the Commission prefer not to have a single, nationwide limit.

A. Most of EchoStar's Existing 28 GHz Earth Stations Would Violate the Siting Limitations Adopted in This Proceeding

Section 25.136(a)(4) establishes that an applicant for a 28 GHz FSS earth station license must comply with a series of limitations on siting in order to avoid having to provide interference protection to UMFUS operations. Two of these limitations are that (1) the permitted interference zone[1] around the proposed earth station may not cover more than 0.1 percent of the population of the county in which the earth station is located, and (2) the interference zone may not contain any major event venue, arterial street, interstate or U.S. highway, urban mass transit route,

[1] For this purpose, the "permitted interference zone" of an earth station is defined as the "area in which the earth station generates a power flux density (PFD), at 10 meters above ground level, of no more than -77.6 dBm/m^2/MHz." *See* 47 C.F.R. § 25.136 (a)(4)(ii).

passenger railroad, or cruise ship port. EchoStar has argued that these conditions would seriously impair the ability of FSS operators to make productive use of valuable spectrum resources and undermine their ability to provide advanced broadband services to consumers across the country, particularly in unserved and underserved areas.[2] In order to corroborate that assertion, EchoStar undertook an analysis of its gateway earth stations that are already authorized and operating in the 28 GHz band with the recently launched EchoStar XIX satellite, to see whether they would have complied with the restrictions in Section 25.136(a)(4).

The table attached hereto in Exhibit A summarizes the results of that analysis. For each EchoStar XIX gateway earth station, the analysis uses actual licensed parameters, including antenna sizes that vary from 5.6 to 13.2 meters. In order to determine the contours of the -77.6 dBm/m^2/MHz permitted interference zone around each earth station, we used the Commission's standard emission mask, with adjustments where appropriate to account for surrounding terrain. This mask produces front lobes in the radiation patterns that become more prominent in gateway stations at more northerly latitudes and at longitudes further removed from the satellite's orbital location at 97.1º W.L.

For each gateway earth station, the table lists the county in which it is located, the aggregate population of the census blocks contained in whole or in substantial part within the interference zone contours, and 0.1 percent of the county's overall population. (Population is based on 2010 census data.) In addition, the table notes the presence of railways, arterial roads, or event venues that appear to fall within those contours using Google Earth Pro.

As shown in Exhibit A, only four of the seventeen grandfathered EchoStar XIX U.S. gateway earth stations would comply with the Commission's current siting restrictions. It is notable that for six of the seven sites with contours that cover no population whatsoever, some other factor (the nearby presence of a road, highway, railway, or event venue) could preclude the location of future earth stations at the site, depending on how the Commission chooses to define the terms in Section 25.136. For example, consider the gateway earth station in North Platte, Nebraska. As shown in Figure 1 below, this earth station is located in the middle of uninhabited farm land. While the permitted interference zone around this site does not contain any population, it does overlap with two roads. The road running east-west is East State Farm Road, which, according to the Nebraska Department of Roads, is classified as an "urban minor arterial road."[3] It is not clear whether this would qualify as an "arterial street" for purposes of the restrictions in Section 25.136 – but if so, this site in the middle of a corn field would not qualify for 28 GHz earth station deployment.

---

[2] *See* Joint Petition for Reconsideration of EchoStar Satellite Operating Company, Hughes Network Systems, LLC, and Inmarsat, Inc., GN Docket No. 14-177, et al., at 9-21 (Dec. 14, 2016).

[3] *See* map of North Platte available at http://roads.nebraska.gov/media/4180/nfc_lincoln_county_cities.pdf. State Farm Road is identified as an urban minor arterial road by the pink line at the bottom of the map.

Figure 1. EchoStar Earth Station Location in North Platte, NE

In order to avoid precluding earth station deployment in areas such as this that are extremely unlikely to affect UMFUS operations, the Commission should revise its rules to allow FSS operators greater flexibility.

B. In Authorizing 39 GHz FSS Operations at the International PFD Limits, the Commission May Want to Consider a Regional Approach

At 37.5-40.0 GHz, radio signals are highly susceptible to "rain fade," the absorption of a significant portion of radio energy as the signal passes through the atmosphere. The effects of rain fade have been extensively studied, and calculation techniques have been documented in relevant ITU-R Recommendations.[4] At these frequencies, rain fade causes substantial loss of satellite signal, with increasing severity in more humid areas and during periods of rainfall. Specifically, at 39 GHz, the attenuation of a horizontally polarized signal due to rain varies from 0.3 dB/km for a rainfall rate of 1 mm/h to 7 dB/km for a rainfall rate of 10 mm/h. Satellite operators can compensate for rain fade by increasing the power of the transmitter as conditions warrant.[5]

---

[4] *See, e.g.*, Recommendation ITU-R P.838-3, Specific Attenuation Model for Rain for Use in Prediction Methods (2005); Recommendation ITU-R P.839-4, Rain Height Model for Prediction Methods (2013).

[5] The Commission acknowledged that rain fade would require FSS operators to increase PFD above the normal clear-sky limits at 39 GHz in order to meet system availability requirements and other satellite performance objectives. *See Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands*, Second Report and Order, 18 FCC Rcd. 25428, ¶ 29 (2003) ("We continue to recognize that rain fading has a significant impact on radio propagation at 40 GHz and that PFD increases and other ameliorating techniques will be necessary to maintain adequate satellite performance even to the limited extent provided for in the 37.5-40.0 GHz band.").

After extensive consideration, the ITU adopted maximum PFD limits for the 39 GHz band, as set forth in Table 21-4 of the Radio Regulations. EchoStar believes that these limits are sufficient to protect terrestrial operations in this band, and the next-generation broadband satellite systems being developed by EchoStar will be able to operate their gateway downlinks in compliance with these internationally approved PFD limits. However, the Commission has adopted general PFD limits that are 12 dB below the ITU limits for clear sky conditions. The Commission also adopted a second set of limits that are 12 dB higher – *i.e.*, at the levels allowed under the ITU Radio Regulations[6] – which apply "during periods when [the] FSS system raises power to compensate for rain-fade conditions at the FSS Earth station."[7] The Commission did not, however, specify the precise conditions under which it would permit such power increases, as that issue was still under study and would be the subject of a further rulemaking.

Use of the 39 GHz band requires flexibility to operate up to the ITU PFD limits to compensate for atmospheric conditions. Thus, at a minimum, the Commission should finally establish the conditions under which satellite operators may utilize the ITU PFD limits to overcome rain fade. As a practical matter, for energy conservation purposes, power increases to overcome rain fade will only be used when conditions warrant, and the use of focused spot beams that is conventional in modern satellite systems would limit any increase in power to coverage areas that are actually experiencing a rain fade event. Terrestrial systems operating within that relatively small footprint would be suffering the same propagation conditions – and using techniques of their own to overcome these effects. Those measures would offset any potential effect from temporarily increased satellite PFD levels.

The ITU PFD limits apply uniformly, and EchoStar would prefer to have a similar approach apply domestically as well. But if the Commission wants to tailor its downlink PFD limits to account for the differing atmospheric conditions across the country, it could adopt a tiered approach that varies by region, with higher PFD levels allowed in more humid parts of the country (where attenuation is greatest) and lower PFD levels allowed in more arid regions. This would be similar to the approach the Commission took with respect to 17/24 GHz BSS systems.[8] Drawing on that approach, EchoStar would support the PFD limits set forth in Table 1 (stated in $dBW/m^2/MHz$, and varying by the angle at which the satellite signal arrives at the earth station site):

---

6 *See* ITU Radio Regs., Art. 21, Table 21-4.

7 47 C.F.R. §§ 25.208(q)(2) (GSO systems), 25.208(r)(2) (NGSO systems).

8 *See* 47 C.F.R. § 25.208(w).

Angle of Arrival (δ°)	West of 100° West	East of 100° West and North of 38° North	East of 100° West and South of 38° North; outside of CONUS
0 – 5	-130	-128.5	-127
5 – 20	-130 + 4/3 (δ – 5)	-128.5 + 4/3 (δ – 5)	-127 + 4/3 (δ – 5)
20 – 25	-110 + 0.4 (δ – 20)	-110 + 0.4 (δ – 20)	-110 + 0.4 (δ – 20)
25 – 90	-108	-106.5	-105

Table 1. Proposed Regional PFD Limits at 39 GHz

The Commission has long recognized the need for satellite operators to use a higher power level to overcome rain fade at 39 GHz, and its rules allow FSS operations in the band at the higher PFD levels established under ITU rules. The ITU limits are designed to protect terrestrial operations in the band even under clear sky conditions. At a minimum, therefore, the Commission should finally implement its own rules by specifying the conditions under which satellites may operate at higher PFD levels. This will better enable satellite system operators to overcome rain fade conditions and reliably provide broadband and other services to U.S. customers. If the Commission prefers a regional approach to these PFD limits, the values proposed in Table 1 above would be appropriate.

Respectfully submitted,

/s/ Jennifer A. Manner

_____

Jennifer A. Manner
Senior Vice President, Regulatory Affairs
EchoStar Corporation
11717 Exploration Lane
Germantown, MD 20876
(301) 428-7140

Attachment

EXHBIT A

ANALYSIS OF AUTHORIZED ECHOSTAR XIX GATEWAY EARTH STATIONS

City	State	Antenna Diameter (m)	Estimated population in contour	0.1% of County Population	Other Factors (arterial roads or event venues in contour, if present)
Billings	MT	5.6	400	151	Contour overlaps Central Avenue, a major E/W street, and baseball fields
San Diego	CA	5.6	1767	3183	
Albuquerque	NM	8.1	984	671	Contour overlaps Lomas Boulevard and a multi-user dwelling census block with 603 residents alone.
Boise	ID	5.6	107	409	
San Jose	CA	5.6	2056	1841	Contour overlaps railroad
Roseburg	OR	8.1	168	107	
Gilbert	AZ	9.2	400	3947	Contour overlaps a railroad and W. Guadalupe Road
Salt Lake City	UT	5.6	0	1063	Contour overlaps Interstate 215
Amarillo	TX	8.1	0	122	Contour overlaps Amarillo Civic Center
Tukwila	WA	8.1	551	2008	Contour overlaps off ramp from WA 99/599 to Tukwila Int'l Blvd
Bellevue	NE	13.2	82	165	
North Las Vegas	NV	5.6	0	2003	
Duluth	MN	8.1	0	200	Contour overlaps Rice Lake Rd, County Highway 4

Bismarck	ND	8.1	133	86	
Cheyenne	WY	9.2	0	94	Contour overlaps Campstool Rd
Missoula	MT	5.6	0	111	Contour overlaps West Broadway St (former US 10) and railroad
North Platte	NE	8.1	0	36	Contour overlaps East State Farm Road